Original Articles

Causes and determinants of neonatal deaths: Evidence from a secondary care hospital in Bangladesh

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Abstract:

Background: Neonatal death is a major barrier to improve child survival in Bangladesh. This study assessed the patterns of neonatal admissions, causes of deaths and associated risk factors to prioritize and design interventions to improve quality of services.

Materials & Methods: This study was conducted at the Satkhira District Hospital, a secondary health care facility in Bangladesh. From January to December 2014 hospital records of neonatal admissions and outcomes were reviewed and analyzed. Risk factors were determined by logistic regression analysis.

Results: A total of 2,632 neonates were admitted during the period. More than one-third had admission bodyweight below 2500 grams. The leading causes of admissions were perinatal asphyxia (39.6%), prematurity/low-birth weight (LBW) (16.3%), pneumonia (11.9%) and sepsis (10.0%). The overall neonatal case fatality rate (CFR) was 11.7%. The main causes of neonatal deaths were perinatal asphyxia (41.6%) and prematurity/ LBW (35.8%). Most of the deaths (74.3%) occurred on first day of life. Significant risk factors for death were body weight on admission <1500 grams (OR: 17.08; 95% CI: 7.22 - 40.44; p<0.001), first day of life (OR: 7.99; 95% CI: 2.86 -22.27; p<0.001).

Conclusions: The main causes of neonatal deaths were perinatal asphyxia and prematurity/LBW and most of the deaths occurred on first day of life.

Keywords: Neonatal mortality, Causes of death, Perinatal asphyxia, Prematurity, Low birthweight

Introduction

Globally, neonatal mortality rate is declining at a slower rate than infant, and under-five mortalities.[1] An estimated 5.9 million children under-five died worldwide in 2015.[2] 45% of these under-five deaths occurred in the neonatal period, mostly (75%) during the first week of life.[2] Greater attention has been given by the international leaders and communities

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in reducing neonatal mortality and morbidity. Specific neonatal target has been introduced in SDG to be achieved by 2030 (SDG Goal 3 target 2).

The neonatal morality in Bangladesh is 28 per 1000 live births.[3] With this estimate about 74,400 neonatal deaths occur in Bangladesh every year, which is the 7th highest number of mortality in the world.[2] Though, during the MDG era, Bangladesh has shown significant progress in reducing infant (declined by 56 percent) and under five mortalities (declined by 65 percent), relatively small progress has been made in neonatal mortality, from 52 to 28/1000 live births (declined by 46 percent).[3]

Neonatal mortality in Bangladesh is nearly three times higher than subsequent 11 months of infancy and contributes to 61 percent of all under-5 deaths.[3] Bangladesh Maternal Mortality Survey 2010' shows

that the main causes of neonatal deaths, as determined by verbal autopsy, are pematurity and low birth weight (11%), birth asphyxia (21%), sepsis (34%), and acute respiratory infections (10%). Many of these deaths are preventable with high impact cost effective evidence-based interventions.[4]

Bangladesh aspires to ending preventable newborn and child deaths. To achieve this goal Government has given priority on maternal and neonatal health on various policy documents such as the health sector program and developed the Bangladesh Every Newborn Action Plan (BENAP).

Saving neonatal deaths depends on community based interventions as well as provision of individualized clinical care at hospital setting.[5] Most of the information related to neonatal morbidity and mortality come from population based studies where the causes of deaths were determined through verbal autopsy, which may not be reliable.[6,7] Very few hospital based studies are available that analyzed the neonatal deaths and their associated risk factors. The aim of this study was to provide information on patterns of neonatal admissions, causes of deaths and associated risk factors to prioritize and design interventions to improve quality of neonatal care services and reduce case fatality rates at hospital setting.

Materials & Methods

This hospital-based cross-sectional study was conducted at the Satkhira District Hospital, situated in the southern part of Bangladesh. The hospital serves over 2 million populations and is the referral hospital for 8 primary level public hospitals and a good number of private clinics. It is a 100-bed hospital having neonatal care unit with facilities of two functioning baby incubators and phototherapy machine. Data for this study were collected from the pediatric admission register for the neonatal admissions during the period of January to December 2014 as a part of ongoing monitoring of safe motherhood promotion project, supported by Japan International Cooperation Agency (JICA).

Detail information for each of the neonatal admissions was collected from the admission register of the pediatric ward. Information available in the register included age, admission body weight, date of admission and discharge, sex, diagnosis (doctor-documented), mode of delivery, place of delivery, outcome of treatment, and referral information. Using a specific pre-coded record sheet, data were extracted directly from the register every month by a staff working in the safe motherhood promotion project after one-day orientation.

Collected data were entered into computer, cleaned for out-of-range errors and analyzed using SPSS version 16 (SPSS Inc, Chicago, IL, USA). Data were analyzed to determine the causes of neonatal admissions, disease specific case fatality rates, causes of neonatal death and socio demographic factors etc. using descriptive statistics, such as frequency, percentage, mean, median and SD, as appropriate. Multiple logistic regressions were done to identify the factors associated with increased risk of death after adjusting for potential confounders and checking for multi co linearity. All the tests were considered significant if p-value was less than 0.05. Ethical approval for the study was obtained from the District Manager of Health (Civil Surgeon) under the Ministry of Health and Family Welfare.

Results

From January to December 2014, a total of 2,632 neonates were admitted in the pediatric ward of the District Hospital constituting 35.1% of all pediatric admissions. Of the admitted neonates, 57% were males. More than half (52.3%) of the neonates were admitted on their first day of life. Median weight on admission was 2600 grams and more than one-third had bodyweight below 2500grams. About a quarter (26.7%) were born at home and more than half (51.5%) were delivered by cesarean section. Average duration of hospital stay was 2 days and 6.1% neonates were referred out for better treatment (Table-I).

Table-II shows the causes of neonatal admission by age. The leading causes of admissions were perinatal asphyxia (39.6%), prematurity/low-birth weight (16.3%), pneumonia (11.9%) and sepsis (10.0%). During hospital stay 303 out of 2592 neonates died. The overall neonatal case fatality rate was 11.7%. The main causes of neonatal
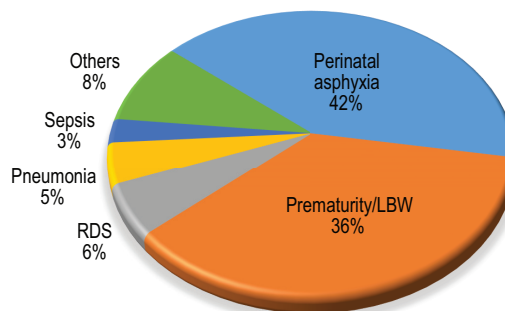
Table I

*Characteristics of neonates admitted at district hospital*

Characteristics	No.	Percentage
Age on admission; days (n=2630)		
1 day	1,377	52.3
2-7 days	783	29.8
>7 days	470	17.9
Median (IQR)	1.0 (4.0)	
Gender (n=2596)		
Male	1,481	57.0
Female	1,115	43.0
Weight on admission; grams(n=2566)		
<1500	157	6.1
1500 to 2490	749	29.2
≥2500	1,660	64.7
Mean (SD)	2560 (670)	
Median (IQR)	2600 (1000)	
Place of delivery (n=977)		
Home	261	26.7
Public hospital	331	33.9
Private hospital	385	39.4
Mode of delivery(n=976)		
Normal vaginal delivery	473	48.5
Cesarean section delivery	503	51.5
Duration of hospital stay; days (n=2568)		
1-2 days	1,311	51.1
3-5 days	825	32.1
>5 days	432	16.8
Median (IQR)	2.0 (2.0)	
Referred out (n=2582)		
Yes	157	6.1
No	2,425	93.9
Treatment outcome (n=2592)		
Discharged alive or referred	2,289	88.3
Died	303	11.7

No. (n=) varied because of missing values

deaths were perinatal asphyxia (41.6%) and prematurity/LBW (35.8%) shown in Fig.-1. About three fourth (74.3%) of the deaths occurred on the first day of life (Fig.-3). The cause specific CFR for hypoxic ischemic encepha-lopathy, prematurity/LBW, respiratory distress syndrome and perinatal asphyxia were 48.5%, 25.4%, 13.6% and 12.2%, respectively (Fig.-2).

Fig.-1: *Causes of neonatal dealths (n=296)*
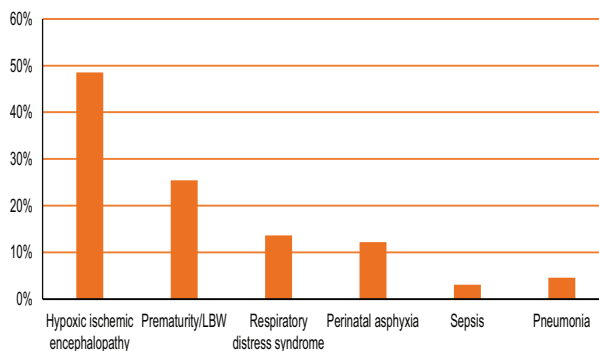
Fig.-2: *Cause specific neonatal case fatality rate*

Table II

Causes of neonatal admission by age

Causes of admission	1 day N (%)	2-7 days N (%)	>7days N (%)	Total N (%)
Perinatal asphyxia	681 (50.7)	297 (38.7)	36 (8.0)	1014 (39.6)
Prematurity &LBW	332 (24.7)	61 (7.9)	24 (5.4)	417 (16.3)
Pneumonia	23 (1.7)	34 (4.4)	247 (55.1)	304 (11.9)
Sepsis	32 (2.4)	142 (18.5)	82 (18.3)	256 (10.0)
Jaundice	10 (0.7)	127 (16.5)	28 (6.2)	165 (6.4)
Respiratory distress syndrome	106 (7.9)	15 (2.0)	4 (0.9)	125 (4.9)
Transient tachypnea	76 (5.7)	14 (1.8)	3 (0.7)	93 (3.6)
Vomiting	25 (1.9)	26 (3.4)	1 (0.2)	52 (2.0)
Hypoxic ischemic encephalopathy	19 (1.4)	11 (1.4)	3 (0.7)	33 (1.3)
Others	39 (2.9)	41 (5.3)	20 (4.5)	100 (3.9)
Total	1,343 (100.0)	768 (100.0)	448 (100.0)	2,559 (100.0)

Table-III shows the results of logistic regression analysis to identify the risk factors for death. Neonates admitted with body weight <1500grams had the highest risk for death (OR: 17.08; 95% CI: 7.22 – 40.44; p<0.001) compared to neonates with weighing ≥2500 grams. The other risk factors for death were first day of life (OR: 7.99; 95% CI: 2.86 – 22.27; p<0.001) and delivery at home (OR: 2.16; 95% CI: 1.17 – 3.98; p=.01).
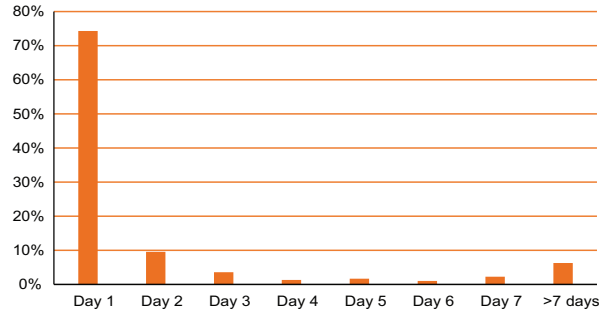

Fig.-3: *Distribution of neonatal death by age (n=296)*

Table III
Risk factor for neonatal death: Logistic regression analysis

Risk factors	Adjusted OR (95% CI)	p-value
Age:		
1 day	7.99 (2.86 – 22.27)	<0.001
2 days	3.06 (0.72 – 13.03)	0.13
3 days	1.54 (0.26 – 9.15)	0.63
>3 days	1.0	
Admission body weight:		
<1500grams	17.08 (7.22 – 40.44)	<0.001
1500 to < 2500 grams	1.95 (1.04 – 3.67)	0.04
≥2500grams	1.0	
Place of delivery:		
Home	2.16 (1.17 – 3.98)	0.01
Hospital	1.0	

Discussion:

During the study period (January to December 2014) 2,632 neonates were admitted in the pediatrics unit of Satkhira District Hospital constituting 35% of total pediatric admissions, which is similar to another study conducted at a secondary level hospital in Bangladesh.[8] Admission of male neonates were higher (57.0%) as found in other studies in Bangladesh and other low income countries.[9-11] This may indicate that the males are at higher risk of becoming sick or societies' preference for better care for male babies.

The major reasons for hospital admissions were Perinatal asphyxia (39.6%), prematurity/LBW (16.3%), pneumonia (11.9%) and sepsis (10.0%). Majority (75.4%) of the neonates admitted on the first day of life were due to perinatal asphyxia and prematurity/LBW, while majority (73.4%) admitted after 7 days of life were due to pneumonia and sepsis. Similar as well as some variations in patterns of admissions are observed in other studies.[8-14] Perinatal asphyxia contributed highest number both for neonatal admission (39.6%) and deaths (41%) that indicates for strengthening immediate newborn care both at health facilities and community levels by the skilled birth attendants.

Another important public health problem is prematurity and LBW. More than one-third (35.3%) of the neonates had admission body weight <2500grams. In contrast, admissions due to prematurity and LBW found in other studies conducted in Hyderabad, Pakistan (27.9-37.7%)[13]; Peshawar, Pakistan (26.5-41.0%)[10]; Tanzania (18.4-29.0%)[14]; and South Africa (23.5-53.0%)[9]. One-fourth of the neonates admitted with body weight <2500 grams died. The risk of dying of a baby

weighing <1500 grams is almost 17 times higher, while the risk is almost 2 times higher if the weight was between 1500 and <2500 grams compared to a baby with admission body weighing ≥2500 grams. These finding indicates for giving proper attention and management (using standard protocol) to these very low birth weight babies at the hospitals.

This study found that infection (sepsis and pneumonia) accounted for about one-fourth (21.9%) of all admissions and case fatality rates were low. About 19% of admissions due to sepsis have been reported by studies conducted in secondary and tertiary level hospitals in Bangladesh.[8,11]

About 60% of the neonates admitted due to infection (pneumonia and sepsis) were aged more than 7 days (table 2), which indicates that these infections are community acquired[15] and deaths from these infections could be averted by early initiation of treatment at community level entry points.

Bang AT et al., reported that case fatality resulted from neonatal sepsis could be reduced by 83% through community level sepsis management by village health workers.[16] Other studies also showed that sepsis can be managed effectively at community level.[17,18] To reduce neonatal mortality from sepsis, in July 2013, National Core Committee for Neonatal Health (NCC-NH) of MOH&FW has approved the new strategy for cord care, such as single chlorhexidine application on first day of life irrespective of place of birth. Since then, the intervention has been scaling up nationwide as a part of essential newborn care. Under the 4thhealth sector program, Bangladesh has taken initiative to manage sepsis at the union level facilities.

In this study, overall neonatal case fatality rate was found 11.7% which is lower compared to other hospital based studies in Bangladesh (20.7%)[8,11]; South Africa (13.8%)[9]; and Pakistan (14.8%).[10] The low CFR in this hospital could be due to quality improvement interventions undertaken by the hospital staff with the support from JICA's Safe Motherhood Promotion Project since 2012. Major QI interventions included need based staff training, protocolized management of neonates, introduction of 5S-Kaizen-Total Quality Management, regular analysis and sharing of data at local level. However, it is very difficult to interpret such results because fatality rate depends on quality of services, severity of cases admitted and referral process.

Our study found that, perinatal asphyxia, prematurity and low birth weight and infection were the leading causes of death accounted for 85% of mortality. WHO also reported the same causes accounting for about 80% neonatal deaths.[19] Other studies in different countries also reported that about three fourths of all the neonatal deaths are due to these three leading causes.[8,9,11,13,14,20,21]

Perinatal asphyxia still remains the major causes of neonatal mortality and morbidity in developing counties. In our study, perinatal asphyxia contributed to 41.0% of all neonatal deaths and the case fatality rate was 12.2%. In a teaching hospital in Bangladesh case fatality rate of perinatal asphyxia was noted as 16.7%.[12] If perinatal asphyxia develops hypoxic ischemic encephalopathy, the CFR increased to 48.5%. This indicates that immediate and effective care of neonates with asphyxia is very important. High mortality from perinatal asphyxia in our hospital could be due to delayed referral of complicated cases from the community or other health facilities. It was not possible to compare the case fatality rate of perinatal asphyxia among the newborns born in the study hospital and outside due to lack of data.

To reduce mortality and morbidity due to perinatal asphyxia, capacity of service providers need to be improved to manage obstetrical complications contributing to perinatal asphyxiaas well as immediate care of newborns. More than three-quarters of perinatal asphyxia can be revived by proper resuscitation.[22] Immediate resuscitation skills are emphasized in Bangladesh National Neonatal Health Strategy.[23] To strengthen newborn resuscitation capacity, Government has already rolled out the Helping Babies Breathe initiative in Bangladesh between 2011 and 2013. However, for reducing mortality and morbidity from asphyxia, special care facilities should be made available for management of post asphyxia complications.[23]

In this study, low admission weight of neonates was found to be the 2nd major cause (32%) of death with a case fatality rate of 31%. For reducing deaths from prematurity, administration of prophylactic corticosteroid in preterm labor is recommended as the most effective intervention,[24,25] which should be promoted and practiced at all levels. Other effective interventions for improved neonatal survival including preterm babies are use of antibiotics for premature rupture of membrane, delayed cord clamping,

treatment of infection, vitamin K supplementation, thermal care, early breast feeding, hospital based kangaroo mother care etc.[4,25]

In the current study, infection comprised of pneumonia and sepsis was the 3rd leading cause of death accounting for 8% of all neonatal deaths. According to WHO, infection is accounted for 36% and only sepsis is accounted for 14% of all neonatal deaths worldwide. In this study, sepsis accounted for 3% of all neonatal deaths (CFR is 3%) which is much lower than other hospital based study findings.[8-11] Low case fatality rate for infection in this hospital could be due to early detection and administration of appropriate antibiotics and referral of severe cases at higher level.

First day of life is very critical for neonates. Globally, 25- 45% neonatal deaths happen within the first 24 hours of life.[19] BDHS 2011 reported that in Bangladesh about 50% of neonatal deaths occur on 1st day of life. In our study, among all neonatal death 74.3% occurred on the first day. Improved care during pregnancy, childbirth and immediate newborn care may reduce the preventable deaths.

This study has a number of limitations. This study was conducted at a secondary level hospital using the data from the registers. There are many factors that influence the neonatal deaths and it was not possible to include all these variables in this study. On the other hand, the diagnosis considered in this study was doctor reported and was not mostly supported by investigations, as appropriate. Moreover, a substantial number of neonates had two diagnoses. We have however considered the primary cause as the diagnosis. Since this is a hospital based study, the findings may vary from community based study. Moreover, the findings may not be generalized to all the secondary level hospitals. The overall and cause specific case fatality rate should be interpreted cautiously, since they are affected by quality of care, referral process and availability of 24/7 services. It may happen that more severe cases are referred to higher facilities to keep the fatality rates lower. Interventions are therefore needed both at facility and community levels. Facility level interventions may include introduction of evidence-based practices for newborn care, capacity building of staff, supply of necessary logistics, and regular clinical audits.

Conclusions:

Perinatal asphyxia, prematurity/low birth weight and infection were the commonest causes of hospital admission as well as neonatal deaths. The significant risk factors for death were low birth weight, home delivery and first day of life indicating that highest attention should be given during delivery and immediately after births. Hospital delivery (or by skilled providers), early recognition and utilization of hospitals for neonatal complications should be encouraged at community level.

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